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(54) Title: INVERSE MULTIPLEXER DEVICE

(57) Abstract: The inverse multiplexer device for inverse multiplexing of a broadband data stream received via a broadband data line (7) comprising measuring means (3a-6a) for measuring connection parameters of data transmission lines (3-6) connected in parallel to each other, selection means for selecting a subset of the data transmission lines (3-6) depending from the measured connection parameters and activation means (15a) for activating the selected subset of data transmission lines (3-6) to transmit the received data transmission stream over the selected subset of data transmission lines (3-6).

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Specification

Inverse multiplexer device

5   The invention relates to an inverse multiplexer device for
     inverse multiplexing of a broadband data stream received on
     a broadband data line via a plurality of data transmission
     lines such as twisted-pair telephone copper lines.

.0   Inverse multiplexing techniques can be used to support higher
     frequency bandwidth data transmission using several connec-
     tions instead of a single broadband connection such as a fi-
     bre-optic cable or coaxial link. IMA is an inverse multiplex-
     ing technique related to ATM E1/T1 connections. The inverse
15   multiplexing protocol for ATM used by IMA does not relate to
     the data transfer medium. In the IMA-inverse multiplexing
     technique the data transfer quality of connection lines is
     not measured and evaluated.

20   As can be seen from figure 1 a plurality of DSL-connection
     lines is provided within a cable trunk. Each DSL-connection
     line consists of a twisted-pair telephone line made of cop-
     per. Environmental noise and signal disturbances created by
     other DSL-connection lines within the same cable trunk and
25   the signal attenuation of the twisted -pair telephone line
     limit the amount of total bandwidth available over the aggre-
     gated connection lines. The cross-talk between the different
     DSL-connection lines reduces the possible operating distance
     for data transmission. Since in the IMA inverse multiplexing
30   technique the quality of the data transmission line is not
     evaluated a data transmission line is activated which does
     not provide the best possible data transmission.

     Accordingly it is an object of the present invention to pro-
35   vide an inverse multiplexer device and a method for inverse
     multiplexing which provides a high reliability of the data
     transmission through multiple data transmission lines.

The present invention provides an inverse multiplexer device
for inverse multiplexing of broadband data stream received
via a broadband data line comprising:

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measuring means for measuring connection parameters of data
transmission lines connected in parallel to each other,
selection means for selecting a subset of the data transmis-
sion line depending from the measured connection parameters,
10 and
activation means for activating the selected subset of data
transmission lines to transmit the received broadband data
stream over the selected subset of data transmission lines.

15 In a preferred embodiment of the inverse multiplexer device
according to the present invention the data transmission
lines are DSL-connection lines.

The DSL-connection lines consists preferably of twisted-pair
20 copper lines.

In a preferred embodiment the measuring means measures intra-
connection parameters, cross-connection parameters and gen-
eral-connection parameters of the data transmission line.
25

The intra-connection parameters measured by the measuring
means are preferably the bit error rate BER, the signal to
noise ratio SNR and the spectral line characteristic of each
transmission line.
30

The cross-connection parameters measured by the measuring
means are preferably the cross-talk magnitudes of cross-talk
between all data transmission lines.

35 The general-connection parameters measured by the measuring
means are preferably ambient noise magnitudes of ambient
noise effecting the data transmission lines.

In a preferred embodiment the inverse multiplexing device according to the present invention comprises several DSL-modems wherein each modem is connected to one data transmission
5   line.

Each modem measures preferably the connection parameters of the respective data transmission line.

10   In a further preferred embodiment of the inverse multiplexer device according to the present invention the data transmission lines connect the inverse multiplexer device to a demultiplexing device for demultiplexing the data stream transmitted by the inverse multiplexing device via the data transmis-
15   sion lines.

The broadband data line for transmitting the broadband data stream to the inverse multiplexer device is preferably a glass fibre, 100 base T or a coax cable.
20
The inverse multiplexing device according to the present invention is in a preferred embodiment connected via the data line to a chopper device for chopping the received broadband data stream into data cells of a predetermined size.
25
The demultiplexing device comprises in a preferred embodiment data reception buffers wherein each reception buffer is connected to a respective data transmission line for buffering data cells multiplexed by the inverse multiplexer device.
30
The demultiplexing device is connected in a preferred embodiment to a reconstructor for reordering the data cells using tags attached to each data cell generated by the chopper device.
35
The broadband data stream received by the inverse multiplexer device according to the present invention is preferably a

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PDH-data stream, SDH-data stream, a ATM-data stream, an
Ethernet-data stream, a HDLC-data stream or a SONET-data
stream.

5   In a further preferred embodiment of the inverse multiplexer
     device according to the present invention the selection means
     is a central processing unit CPU.

     The central processing unit CPU is in a preferred embodiment
10   integrated within the inverse multiplexer device according to
     the present invention.

     The present invention further provide a multiplexer system
     for multiplexing a broadband data stream to transmit the
15   broadband data stream via a plurality of data transmission
     lines connected in parallel to each other comprising the in-
     verse multiplexing device and a demultiplexing device con-
     nected to the inverse multiplexing device through he plural-
     ity of data communication lines.
20
     The present invention provides further a method for inverse
     multiplexing of broad band data streams, wherein
     the connection parameters of a plurality of data transmission
     lines are measured,
25   a subset of the plurality of data transmission lines is se-
     lected depending from the measured connection parameters,
     and wherein the selected subset of data transmission lines is
     activated to transmit the broadband data stream via the se-
     lected subset of data transmission lines.
30
     The data transmission lines are measured preferably subse-
     quently.

     In a preferred embodiment of the method for inverse multi-
35   plexing according to the present invention for each data
     transmission line intra-connection parameters, cross-

connection parameters and general connection parameters are
measured separately.

In a further preferred embodiment of the method for inverse
5   multiplexing according to the present invention the measured
connection parameters of all data transmission lines are used
to generate a connection parameter matrix.

The data transmission lines which are not selected are pref-
10   erably deactivated.

The measuring of the data transmission lines is in a pre-
ferred embodiment of the method according to the present in-
vention repeated periodically.
15
In a still further embodiment of the method for inverse mul-
tiplexing according to the present invention a deactivated
data transmission line is selected and activated to substi-
tute an activated data transmission line when the connection
20   parameters of the activated data transmission line indicate
that the data transmission through this data transmission
line has degraded.

Preferred embodiments of the inverse multiplexer device and
25   the method for inverse multiplexing according to the present
invention are described in detail with respect to the at-
tached figures.

Figure 1 shows a cross section through a cable trunk consist-
30   ing of a plurality of data transmission lines to explain the
problem underlying the present invention.

Figure 2 shows one data path of a multiplexer system for mul-
tiplexing a broadband data stream via a plurality of data
35   transmission lines connected in parallel to each other in-
cluding an inverse multiplexer device IMUX according to the
present invention.

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Figure 3 shows a block diagram of an inverse multiplexer device IMUX according to the present invention.

Figure 4 is flow chart of a preferred embodiment of the
5   method for inverse multiplexing of a broadband data stream according to the present invention.

In figure 2 one data path of a multiplexer system for multi-plexing a broadband data stream includes an inverse multi-
10   plexing device 1 according to the present invention. The mul-tiplexer system comprises two separated data paths for bidi-rectional data transmission. The inverse multiplexing device 1 is connected to a demultiplexing device 2 through a plural-ity of data transmission lines 3, 4, 5, 6 such as twisted-
15   pair telephone wires made of copper. The inverse multiplexer device 1 includes several data transfer modems 3a, 4a, 5a, 6a to transmit data cells through data transmission lines 3, 4, 5, 6 to data modems 3b, 4b, 5b, 6b within the demultiplexing device 2. The inverse multiplexing device 1 according to the
20   present invention is connected to a broadband data line 7 and receives a broadband data stream over the broadband data line 7 from a chopper device 8. The chopper device 8 receives a broadband data stream from a data source through a data line 9 and chops the broadband data stream received via a data
25   line into data cells having a predetermined fixes size. The original data stream on line 9 is transmitted as payload in-side the data cells D generated by the chopper device 8.

The inverse multiplexer device 1 according to the present in-
30   vention receives the data cell D and performs an inverse mul-tiplexing to distribute the received data cells for data transmission over a subset of data transmission lines which provide the highest reliability for data transmission.

35   The demultiplexing device 2 demultiplexes the data streams transmitted by the inverse multiplexer device 1 via the se-lected subset of transmission lines and sends the demulti-

plexed data cells through a data line 10 to a reconstructor
11 for reordering the data cells D.

The inverse multiplexing device 1 transmits the data cells D
5   received from the chopper 8 through the selected active data
transmission lines in known order. The demultiplexer 2 re-
ceives the data cells in a different order due to connection
delay differences. Accordingly the order of the data cell D
sent by demultiplexer 2 via line 10 differs from the order of
10   data cells D received by the inverse multiplexing device via
line 7. The reconstructor 11 reorders the data cell using
tags attached to each data cell by the chopper device 8 dur-
ing the generation of the data cell D. The reconstructor 11
reorders the data cell to get the original data stream re-
15   ceived by the chopper device 8 via line 9. The data cells
which has been reordered by the reconstructor 11 are output
through the data line 12 for further data processing.

The inverse multiplexing device 1 and the demultiplexing de-
20   vice 2 are both connected through lines 14, 16 to a central
processing units 15a, 15b for data management and multiplex-
ing control.

Figure 3 shows a block diagram of an inverse multiplexer de-
25   vice 1 according to the present invention. The inverse multi-
plexing device 1 includes several modems 3a, 4a, 5a, 6a each
connected to a respective data transmission line 3 to 6. Each
modem 3a-6a is connected through lines 13a-16a to a data
transmission terminal 17 of the inverse multiplexing device
30   1. Further each modem 3a -6a is connected via lines 13b -16b
to data transmission terminals 13c-16c for connecting the in-
verse multiplexing device 1 with the data transmission lines
3-6. Each modem 3a-6a measures the connection parameters of
the respective data transmission lines 3-6 and transfers the
35   measured connection parameters via respective parameter
transfer lines 13d- 16d to a parameter transfer terminal 18
of the inverse multiplexing device 1. The parameter transfer

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terminal 18 is connected to the central processing unit 15a
which receives the measured connection parameters of all data
transmission lines 3-6 and stores the connection parameters
into storage means 19 connected to the central processing

5   unit 15a via a line 20 for further evaluation of the connec-
tion parameters.

In a preferred embodiment of inverse multiplexing device 1
the central processing unit 15a and the storage means 19 for

10 storing the measured connection parameters are integrated in
the inverse multiplexing device 1.

Modems 3a-to 6a are preferably DSL-modems. Each DSL-modem 3a-
6a measures intra-connection parameters, cross-connection pa-

15 rameters and general-connection parameters of the respective
connection line 3-6.

The intra-connection parameters measured by the modem are the
bit error rate BER, the signal-noise-ratio SNR and the spec-

20 tral line characteristic of the data transmission line 3-6.

The cross-connection parameters measured by a modem 3a-6a are
the cross-talk magnitudes of cross talk between the respec-
tive connection line and the other remaining connection

25 lines.

As general-connection parameters the modems 3a-6a measure the
ambient noise magnitudes of ambient noise effecting the re-
spective connection line.

30

The measured connection parameters of all connection lines 3-
6 are stored by the central processing unit 15 in storage
means 19. On the basis of the stored connection lines parame-
ters a parameter matrix P is generated by the central proc-

35 essing unit 15a before the selection of an optimal subset of
data transmission lines 3-6.

$$P = \begin{bmatrix} A_{1,1} & A_{1,2} & & & \\ A_{2,1} & A_{2,2} & & & \\ & & \ddots & & \\ & & & A_{N,N-1} & \\ & & A_{N-1,N} & A_{N,N} \end{bmatrix}$$

Wherein A_{ii} are the intra channel quality parameters based on
5   bit error rate BER, signal to noise ratio SNR,
wherein A_{ij} are cross channel quality parameters based on
cross talk between different data transmission lines, and
wherein N is the number of all available data transmission
lines connecting the inverse multiplexing device 1 to the de-
10   multiplexing device 2 as shown in figure 2.

In the example shown in figure 2 the number N of available
data connection lines is four. The central processing unit
evaluates the parameter matrix P and selects a subset of K
15   data transmission lines from a total of N available connec-
tion lines, wherein the subset of K data connection lines se-
lected by the central processing unit provides for the high-
est reliability in data transmission between the inverse mul-
tiplexing device 1 and the demultiplexing device 2.
20
After selection of the best subset of data transmission lines
the central processing unit 15a activates the respective mo-
dems 3a-6a via control lines 13e-16e connected to a control
terminal 21 for data transmission .The modems of the remain-
25   ing not selected data transmission line are deactivated. Dur-

ing the selection process the central processing unit 15a
scores all DSL-connections from the best data transmission
connection to the worst data transmission connection line.
The best K data transmission line needed to transport the re-
5   quired bandwidth are turned on. The rest of the data trans-
mission lines are turned off. The process of data line qual-
ity measurement takes place in all active data transmission
lines K. In case of a data line failure due to disconnection
or in case of a very high bit error rate of an activated data
10   transmission line this data transmission line is turned off
by deactivating the respective modem and the best next avail-
able data transmission line is turned on to substitute the
defect data transmission line.

15   The measurement of the connection parameters of the data
transmission line is repeated periodically. Switching occurs
when one of the data transmission lines is disconnected or
has a high bit error rate BER. Using a set of N data connec-
tion lines with a theoretical bandwidth which is wider than
20   the requested bandwidth for data transmission and selecting
the best subset of data connection line provides a high
fault tolerance and better connection quality in terms of bit
error rate BER or signal to noise ratio SNR. The selection of
the best subset of data connection lines is performed auto-
25   matically and the dynamically switching between all available
data connection lines provides best aggregated data transmis-
sion connection between the inverse multiplexing device 1 and
the demultiplexing device 2.

30   In the example shown in figure 2 the central processing unit
15a selects as an optimal subset of data transmission line
the data transmission line 3, 4, 5 whereas the data transmis-
sion line 6 is switched off. In case that, e. g. data trans-
mission line 3 is disconnected data transmission line 6 will
35   be switched on by the central processing unit 15 to substi-
tute the disconnected data transmission line 3. The data
transmission lines which are not switched on by the central

11

processing unit 15a provide for a redundancy in the data
transmission. In case that a higher frequency bandwidth is
necessary for data transmission back-up data transmission
lines can be switched on to provide for the necessary total
5   frequency bandwidth.

The data connection can be based on any DSL-technology such
as HDSL, SDSL, ADSL or VDSL. The broadband data stream re-
ceived by the inverse multiplexing device 1 through broadband
10   data line 7 can be any kind of data stream such as PDH-data
stream, SDH-data stream, ATM-data stream, Ethernet-data
stream, HDLC-data stream or a SONET-data stream. The multi-
plexing system shown in figure 2 can be used both in the up-
stream and in the downstream data transfer direction when us-
15   ing DSL-technology. The central processing units 15a, 15b on
both sides handle the selection process and the redundant
line switching process. The inverse multiplexing device 1
guarantees a high bandwidth, full duplex data bit stream from
point to point via the best K data connection lines with an
20   aggregated bandwidth. The other N-K data connection lines are
used as back-up links for the system. The detection of a
fault data connection line in terms of bit error ratio BER or
signal to noise ratio SNR will lead to hot swapping of the
faulty data connection line with the best available back-up
25   link.

The inverse multiplexing device 1 according to the present
invention can be powered locally from a powers source or can
be powered remotely over the connections lines.
30
The twister-pair data connection lines can connect a central
office exchange to a cabinet or curb, a curb to a basement or
an end user or two rooms inside the same building. The in-
verse multiplexing device 1 reduces the costs for high-speed
35   data transmission to a wide extend because conventional data
transmission lines can be used for a broadband data transmis-
sion. The transferred data are transmitted over the same con-

nection medium such as cable trunk thus introducing a very
small time delay. The multiplexer system shown in figure 2
supplies high bandwidth connection without the need of in-
stalling an expensive new fibre optic connection. Existing
5   copper based twisted pairs are used instead.

Figure 4 shows a preferred embodiment for a method for in-
verse multiplexing of a broad band data stream according to
the present invention.
10

The process starts with step 0 and in step 1 all transmitters
T_x, i.e. modems 3a-6a within the inverse multiplexing device
are turned off.

15   In step S2 the ambient noise on all receivers R_x, i.e. modems
3b-6b within the demultiplexing device 2 is measured.

In step S3 the first transmitter, i.e. modem 3a within in-
verse multiplexing device 1 is turned on.
20

In step S4 it is checked whether the receiver 1, i.e. modem
3b within the demultiplexing device 2, is locked to the
transmitting device 3a.

25   In case that modem 3b within the demultiplexing device 2 is
locked to respective transmitting device 3a the bit error ra-
tio BER and the spectral line characteristic of the data
transmission line 3 is measured as intra-connection parame-
ters of the data transmission line within step S5.
30

In a further measuring step S6 the cross-talk between the
data communication line 3 and the remaining other communica-
tion lines 4-6 is measured.

35   The process continues with step S7 wherein all operating
transmitting devices are turned off again.

Then in step S8 the next transmitting device such as modem 4a
within the inverse multiplexing device 1 is turned on and the
measuring steps S4 to S6 are repeated. This in done for all
transmitting devices 3a-6a of the inverse multiplexing device

5   1 until in step 10 it is detected that the connection parame-
ters of the last data transmission line have been measured.

After all connection parameters have been detected a parame-
ter matrix P is generated in step S11.

10

The central processing unit 15a selects the best K data con-
nection lines on the basis of the parameter matrix P in step
S12.

15   In step S13 the modems of the selected data transmission
lines are activated by the central processing unit 15 for
data transmission.

The process shown in figure 4 it stops in step S15.

20

The measuring of the data transmission lines is repeated pe-
riodically. A deactivated data transmission line is selected
and activated to substitute an activated data transmission
line when the connection parameters of the activated data

25   transmission line indicate that the data transmission through
this data transmission line has degraded.

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Claims

1. An inverse multiplexer device for inverse multiplexing of
a broadband data stream received via a broadband data line
5   (7) comprising:

measuring means (3a-6a) for measuring connection parameters
of data transmission lines (3-6) connected in parallel to
each other;
10

selection means for selecting a subset of the data transmis-
sion lines (3-6) depending from the measured connection pa-
rameters; and

15 activation means (15a) for activating he selected subset of
data transmission lines to transmit the received data trans-
mission stream over the selected subset of data transmission
lines.

20 2. The inverse multiplexer device according to claim 1,
wherein the data transmission lines (3-6) are DSL-connection
lines.

3. The inverse multiplexer device according to claim 2,
25 wherein the DSL-connection lines (3-6) are twisted-pair tele-
phone copper lines.

4. The inverse multiplexer device according to one of he pre-
ceding claims,
30 wherein the measuring means (3a-6a) measure intra-connection
parameters, cross-connection parameters and general-
connection parameters.

5. The inverse multiplexing device according to one of the
35 preceding claims,
wherein the intra-connection parameters measured by the meas-
uring means (3a-6a) are bit error rates (BER), signal to

noise ratio (SNR) and spectral line characteristic of each
data transmission lines (3-6).

6. The inverse multiplexer device according to one of the
preceding claims,
wherein the cross-connection parameters measured by the meas-
uring means (3a-6a) are cross talk magnitudes of cross talk
between a respective data transmission line and the remaining
other data transmission lines.

7. The inverse multiplexing device according to one of the
preceding claims,
wherein the general connection parameters are ambient noise
magnitudes of ambient noise effecting the data transmission
via the data transmission line (3-6).

8. The inverse multiplexing device according to one of the
preceding claims,
wherein the inverse multiplexing device (1) comprises several
DSL-modems (3a-6a), wherein each modem is connected to one
respective data transmission line (3-6).

9. The inverse multiplexing device according to one of the
preceding claims,
wherein DSL-modem (3a-6a) measures the connection parameters
of the respective data transmission line (3-6).

10. The inverse multiplexing device according to one of the
preceding claims,
wherein the data transmission lines (3-6) connect the inverse
multiplexing device (1) with a demultiplexing device (2) for
demultiplexing the data streams transmitted by the inverse
multiplexing device (1) via the data transmission lines (3-
6).

11. The inverse multiplexing device according to one of the
preceding claims,

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wherein the broadband data line (7) is a glass fibre, 100
base T or coax cable.

12. The inverse multiplexing device according to one of the
preceding claims,
wherein the inverse multiplexing device (1) is connected via
the broadband data line (7) to a chopper device (8) for chop-
ping the received broadband data stream into data cells D of
a predetermined size.

13. The inverse multiplexing device according to one of the
preceding claims,
wherein the demultiplexing device (2) comprises reception
data buffers, wherein each buffer is connected to a respec-
tive data transmission line(3-6) for buffering data cells D
multiplexed by the inverse multiplexing device (1).

14. The inverse multiplexing device according to one of the
preceding claims,
wherein the demultiplexing device (2) is connected to a re-
constructor (11) for reordering the data cells D using tags
attached to each data cell generated by the chopper device
(8).

15. The inverse multiplexing device according to one of the
preceding claims,
wherein the broadband data stream is a PDH-data stream, a
SDH-data stream, an ATM-data stream, an ETHERNET-data stream,
a HDLC-data stream or a SONET-data stream.

16. The inverse multiplexing device according to one of the
preceding claims,
wherein the selection means and the activation means are
formed by a central processing unit (15a) integrated within
the inverse multiplexing device(1).

17. Multiplexing system for multiplexing a broadband data stream to transmit the data stream via a plurality of data transmission lines (3-6) connected in parallel to each other comprising the inverse multiplexing device (1) according to

5 claim 1 and
a demultiplexing device (2) connected to the inverse multi-plexing device (1) through the plurality of data transmission lines (3-6).

10 18. The method for inverse multiplexing of a broadband data stream comprising the following steps:

(a) measuring the connection parameters of a plurality of data transmission lines (3-6);

15
(b) selecting a subset of the plurality of data transmission lines (2-6) depending from the measured connection parame-ters;

20 (c) activating the selected subset of data transmission lines (2-6) to transmit the broadband data stream via the selected subset of data transmission lines (3-6).

19. The method according to claim 18 ,
25 wherein all data transmission lines (3-6) are measured subse-quently.

20. The method according to one of the preceding claims 18 to 19,
30 wherein for each data transmission line (3-6) intra-connection parameters, cross-connection parameters and gen-eral connection parameters are measured.

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21. The method according to one of the preceding claims 18 to
20,
wherein a connection parameter matrix P is generated depend-
ing from the measured connection parameters of all data
5   transmission lines (3-6).

22. The method for inverse multiplexing according to one of
the preceding claims 18 to 21,
wherein the data transmission lines (2-6) which have not been
10   selected are deactivated.

23. The method for inverse multiplexing according to one of
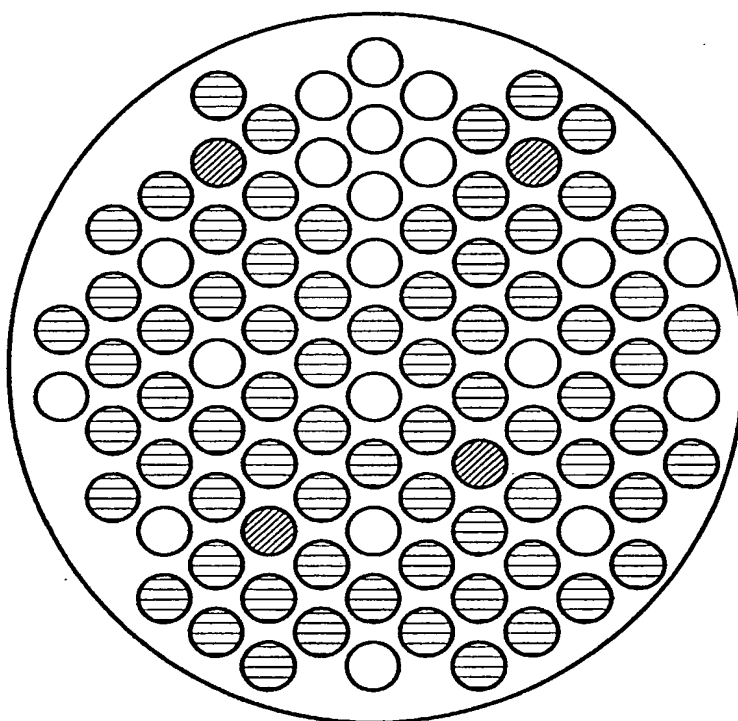the preceding claims 18 to 22,
wherein the measuring of the data transmission lines (2-6) is
15   repeated periodically.

24. The method for inverse multiplexing according to one of
the preceding claims 18 to 23,
wherein a deactivated data transmission line is selected and
20   activated to substitute an activated data transmission line,
when the connection parameters of the activated data trans-
mission lines indicate that the data transmission through
this data transmission lines has degraded.

FIG 1

○ Active Connection Line
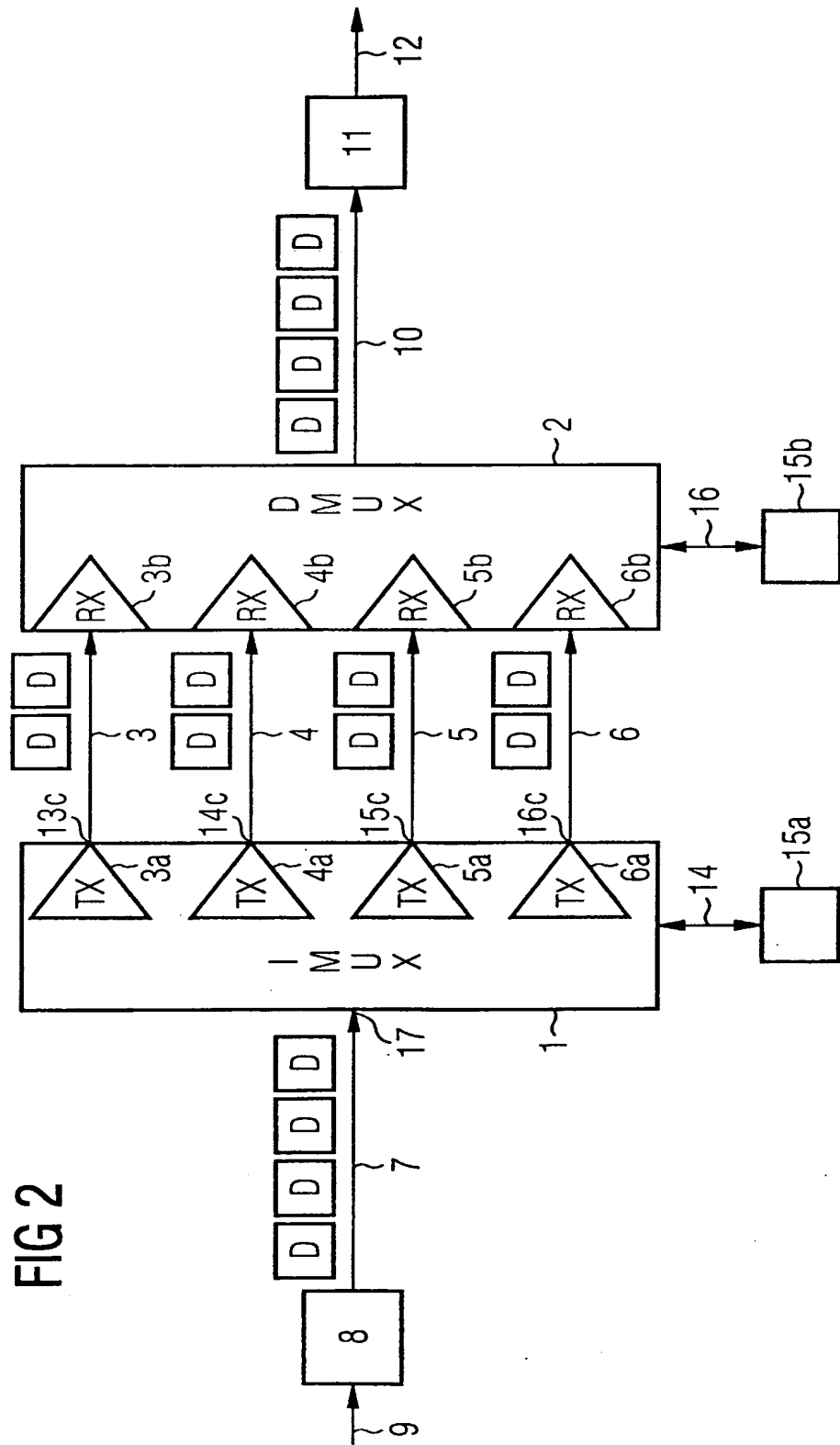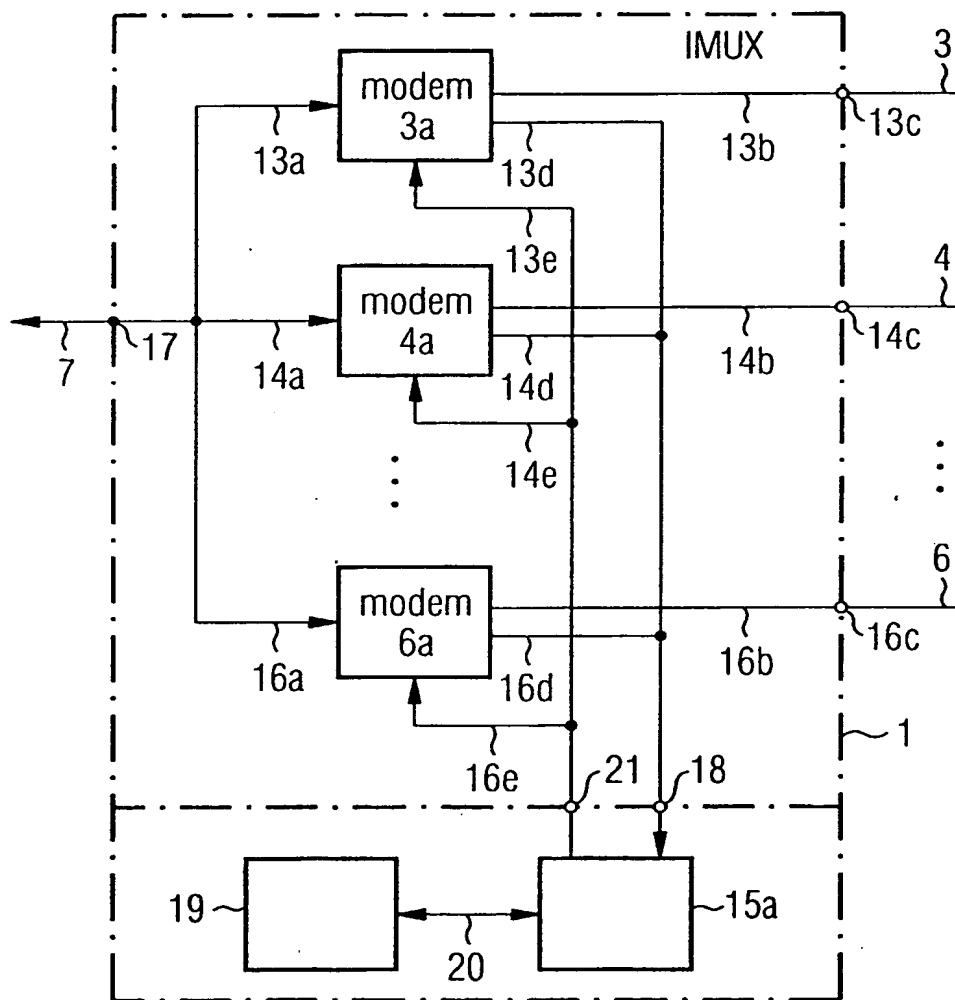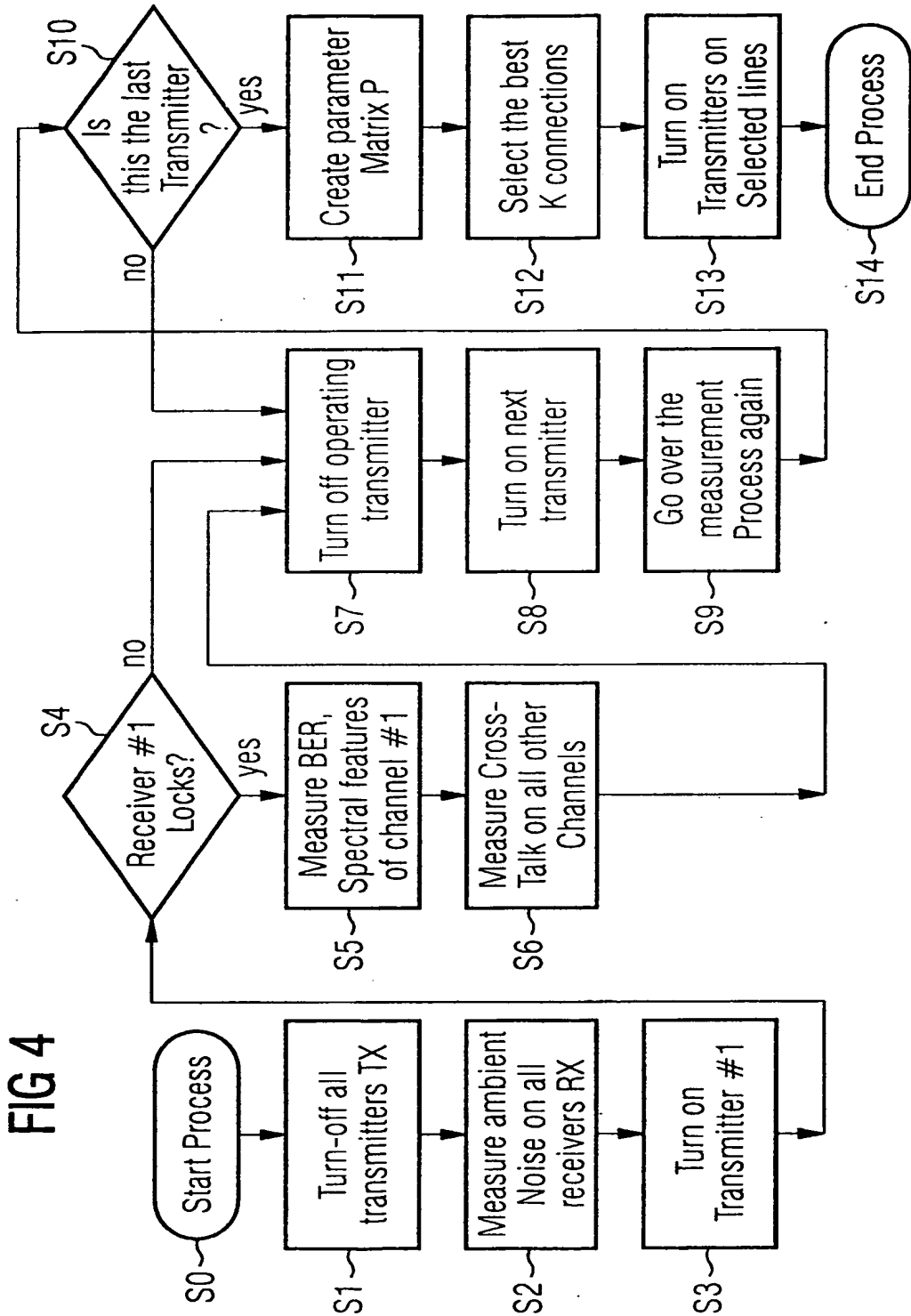
◧ Backup Connection Line

⊜ Inactive Connection Line

FIG 2

FIG 3

4/4

FIG 4

S0 — Start Process

S1 — Turn-off all transmitters TX

S2 — Measure ambient Noise on all receivers RX

S3 — Turn on Transmitter #1

S4 — Receiver #1 Locks?

yes → S5 — Measure BER, Spectral features of channel #1

S6 — Measure Cross-Talk on all other Channels

no →

S7 — Turn off operating transmitter

S8 — Turn on next transmitter

S9 — Go over the measurement Process again

S10 — Is this the last Transmitter ?

no →

yes → S11 — Create parameter Matrix P

S12 — Select the best K connections

S13 — Turn on Transmitters on Selected lines

S14 — End Process

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7   H04L12/56   H04Q11/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7   H04L   H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category°	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 002 670 A (RAHMAN RESHAD ET AL) 14 December 1999 (1999-12-14) claims 1-3	1-24
A	US 5 617 417 A (SCHMIDT URI ET AL) 1 April 1997 (1997-04-01) column 1, line 33 column 1, line 43 column 2, line 56 -column 3, line 9	1-24
A	WO 99 39468 A (EDVARDSEN EINAR ;TELENOR AS (NO); ORMHAUG TERJE EDVARD (NO)) 5 August 1999 (1999-08-05) claims 1-3	1-24

☐ Further documents are listed in the continuation of box C.   ☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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